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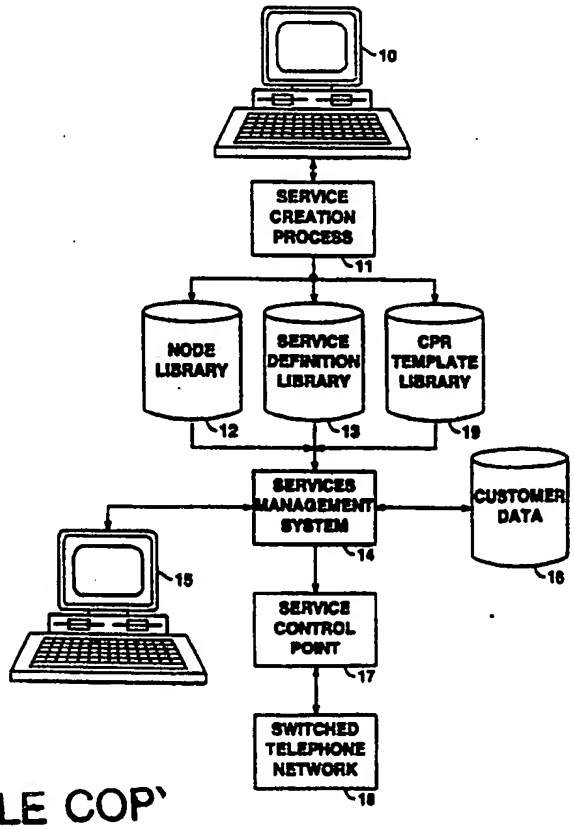
(54) Title: VISUAL PROGRAMMING OF TELEPHONE NETWORK CALL PROCESSING LOGIC

(57) Abstract

A system for creating and modifying intelligent telephone network call processing logic trees which can be customized for individual customers and created in a user-friendly visual environment (10, 15, Fig. 3-5). Service primitives are defined as logical graph nodes (20, Fig. 2, Fig. 3) which can be visually assembled into logic trees (Fig. 5) which represent the service logic flow and which provide default values for all service options. Higher level nodes, assembled from a plurality of service primitives, can likewise be defined and stored (12, 13, 19) for later use as entities in defining yet further call processing logic trees. These call processing logic trees are interpreted to allow the service control point computers (17) to implement the services in the switched telephone network (18) by sequentially executing the specified call processing primitives. A library (12, 13, 19) of defined nodes and defined node assemblies which represent service features can thus be made available to permit graphical manipulation into complete logic trees representing new services. These logic trees are then interpreted by generic programs in the service control point to actually provide the described services.



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+ DESIGNATIONS OF "SU"

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VISUAL PROGRAMMING OF TELEPHONE NETWORK CALL PROCESSING LOGIC

Technical Field

This invention relates to the creation and the provisioning of special customized telephone network services for telephone subscribers and, more particularly, to a portable, visually programmed call processing logic interface for creating and provisioning such customized services.

Background of the Invention

New telephone services are continually being developed by telephone service providers in order to meet the needs of their customers. As such services become available, the telephone companies, subscribers and the users seek yet further improvements in these services. Special services such as 800 service, 900 service, and Private Virtual Networks (PVN) are only a few of the possible services being offered. Other services might well be conceived and might well find extensive use. Unfortunately, however, new telephone services have heretofore required long and expensive design, testing and deployment activities. Such special telecommunications services are typically provided in the public telephone network by computer program call processing sequences residing in digital switches. A typical approach to providing such special services is the introduction into the telephone network of a service implementing network element which interacts with the telephone network so as to implement the telephone services. Such service implementing network elements are variously called Service Adjuncts (SAs), Service Switching Points (SSPs) and Service Control Points (SCPs). One such Service Adjunct is disclosed in S. M. Lin and J. F. Rizzo patent 4,878,240, granted October 31, 1989. A typical Service Control Point is disclosed in J. J. Bernardis patent 4,782,517, granted November 1, 1988. Finally, a typical Service Control Point is disclosed in J. O. Boese et al. application Serial Number 453,042, filed December 12, 1989, a continuation of Serial Number 125,463, filed November 25, 1987, both assigned to applicants' assignee. Each such service implementing network element is equipped with a set of software-implemented service primitives which can be combined in various way to implement a number of telephone services. A set of such primitives for a Service Adjunct is disclosed in the above-mentioned Lin et al. patent. Another

set of primitives for a Service Switching Point is disclosed in the above-mentioned Bernardis et al. patent. Yet another set of such primitives for a Service Control Point is disclosed in "Business Services Database (BSDB): A Service Control Point (SCP) Application Designed to Support Private Virtual Network (PVN) Service," *Technical Advisory TA-TSY-000460*, Issue 2, February 1988, published by Bell Communications Research, Inc., Red Bank, New Jersey. All of these sets of service-implementing primitives are, as a group, generally equivalent, although each is implemented in a slightly different way.

A telecommunications network including such programmable special service implementing components is called an "intelligent network." Such networks make it possible to offer useful and profitable new services such as 800 service, Alternate Billing service and Private Virtual Network service. Intelligent Network Call Processing Logic (INCPL) is the name given to the software that "stitches together" the appropriate service primitives to enable the Intelligent Network mechanism to implement and customize such services without the need for new switch software or hardware. Currently, this INCPL is custom-developed for each new service by a service designer, usually associated with the service provider, installed in the intelligent network service implementing component and supported by a service management system for that service. Thus, instead of the software to support a new service coming from a switch vendor, it can now come from a service vendor, making it possible to reduce the interval between service concept and service offering. Unfortunately, a great deal of time is still required to design custom and implement each new service. Moreover, since such service designs are not highly portable, further delays arise due to the need to provide widely distributed software elements to support the new service in a wide variety of different environments.

Summary of the Invention

In accordance with the illustrative embodiment of the present invention, these and other problems are overcome by providing a user-friendly environment in which intelligent network service primitives can be assembled into telephone services utilizing the graphic capabilities of a computer workstation. If a complete telephone service is analyzed as a graph consisting of nodes and edges, the nodes represent the intelligent network service primitives executable by the service implementing components and the edges represent the

order of execution of these primitives. Both action nodes and decision nodes can be defined in terms of the available service primitives and stored for later use in designing a new telephone service. Moreover, with this representation, the new telephone service can be displayed as a "tree" of such node primitives. Such a tree display can be manipulated graphically to create and alter the logic of a service. An interpretor program, designed for a particular service implementing component, implements such display representations with the available adjunct service primitives. In accordance with this invention, telephone services can be created, manipulated and altered by simple, user-friendly graphical manipulation. Not only can intelligent network service primitives be assembled graphically into new services, but service features can be defined as assemblies of such intelligent network service primitives and, once designed, stored in a library as a single node to be invoked and reused as a single entity in designing a plurality of future services.

More particularly, graphical images or icons on a display screen are used to represent a reusable library of user-defined telephone service primitives. These images or icons can be manipulated graphically so as to assemble the images into logical trees representing new services or new service features. Once fully assembled, the electronic representation of the graphical service tree or service feature tree can be interpreted so as to actually implement the service or service feature. In this way, new telephone services can be designed and implemented much more quickly than in the prior art and thus save much of the expense previously associated with telephone service design and deployment. In addition, the extremely high level representation of telephone services implicit in the graphical service trees is an extremely portable mechanism for quickly and easily deploying such services without extensive reworking of service implementing code. Indeed, the simplicity, speed and flexibility of telephone service design and implementation provided with the present invention can be exploited to allow each individual telephone user to custom design telephone services exactly matching the needs of the customer.

The present invention makes possible dynamic graphical creation, customization and provisioning of new call processing services. Using both simple, predefined primitive nodes and complex, user-defined constructed nodes, new services can be defined rapidly and with great ease. A new service is

created visually as a logic tree with nodes defined to represent a high-level abstraction of the primitive call processing actions or call processing decision points or combinations of such primitive actions and decision points. This tree, or the electronic representation of the tree, is called a Call Processing Record (CPR) since it defines exhaustively the processing necessary to provide an individual call with the defined service. Service providers, as well as subscribers themselves, can customize and provision the graphically defined service to satisfy specific customer needs by dynamically modifying and parameterizing the relevant graphical call processing record trees. The thus provisioned call processing records representing the service can then be translated from the user-friendly visual format to a rigorous program-generating format which can be generically interpreted by existing service implementing components. The distribution and installation of such call processing records to appropriate service implementing components in an intelligent network enables the thus-described service to become instantly available to telephone subscribers.

There are three steps in this service specification process: 1) defining the node primitives, 2) establishing which nodes can be used in a particular service, and, 3) creating call processing records defining a particular service using the nodes that have been defined, and to which can be added the customer-specific parameters necessary to completely specify the service. These three steps can be iterated interactively to improve the quality of the resulting service, to remove "bugs," or to provide new features and capabilities.

Other aspects of a service creation and provisioning system are disclosed and claimed in the copending applications of D. L. Babson, J. A. Bajzath, Jr. and T. C. Ely, Serial Numbers _____, all filed of even date herewith and assigned to applicants' assignee.

Brief Description of the Drawings

A complete understanding of the present invention may be gained by considering the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 shows a block diagram of an intelligent telephone network including a graphical telephone service design and deployment system in accordance with the present invention;

FIG. 2 shows a flowchart of the service definition, provisioning and implementation processes taking place in the system of FIG. 1;

FIG. 3 is a graphical representation of a display screen used to define new telephone service primitives in the system of FIG. 1;

FIG. 4 is a graphical representation of a display screen used to define the allowable subset of telephone service nodes which are used to design and implement a particular advanced telephone service in the system of FIG. 1; and

FIG. 5 is a graphical representation of a display screen used to customize a logical tree template of service primitives by specifying all of the customer-dependent variables required to implement a particular new service for a particular customer in the system of FIG. 1.

To facilitate reader understanding, identical reference numerals are used to designate elements common to the figures.

Detailed Description

Referring more particularly to FIG. 1 of the drawings, there is shown a general block diagram of an intelligent network telephone service design and deployment system comprising a workstation 10 for designing new telephone services in accordance with the present invention. As will be described hereinafter, workstation 10 includes graphical facilities for defining customer special service nodes in terms of service control point primitives, bounding new special services in terms of the thus defined nodes which can be used for that service, and assembling these telephone service nodes into templates or assemblies of call processing logic units capable of providing the new telephone special services. Service creation process 11 provides the software for supporting these facilities and includes standard window processing capability as well as mouse or other visual selection apparatus support, and is typically stored in the program memory of workstation 10. Storage device 12 stores a library of the electronic representations of all of the nodes previously specified, both simple primitive nodes and more complex, user-defined service feature nodes. Storage device 13 stores the definitions of all of the services defined at workstation 10, where a service definition is simply the specification of which of the defined nodes (primitives) can be used to implement a particular service. Storage device 19 stores templates of multinode fully designed services as call processing

records. In the present application, a "template" is a fully designed service, but without all of the variable parameters which are dependent on the actual customer using the service. Although shown as separate storage devices, stores 12, 13 and 19 can be contained in a single storage device.

The present invention contemplates three steps in creating new services, defining graphical nodes from which services can be assembled (node definition), prescribing which nodes can be used in a particular service (service definition) and prescribing the logical interrelationships of the various nodes necessary to produce the desired service (call processing record creation). As new nodes are defined, they are stored in node library 12 for later retrieval and reuse. Once a new service is fully defined in terms of primitive or complex service nodes, a representation of that service definition is stored in a service definition storage facility 13. Once the service nodes are assembled into a service logic tree or template, that template is stored as a call processing record (CPR) in call processing record template library 19. The templates in library 19 require only the specification of certain customer-dependent variables required to fully implement the service for a particular customer.

A services management system 14 provides administrative control over a plurality of service control points such as service control point 17 which actually implement the new services by exchanging network control messages with the switched telephone network 18. The details of the service control point 17, along with its interaction with the switched telephone network 18, are detailed in the aforementioned copending application of J. O. Boese et al. Since the structure and operation of the service control point 17 and the switched telephone system 18 comprise well-known telephone facilities, they will not be further described here. Sufficient to note that these elements are able to implement telephone network service primitives which can be utilized to realize telephone services and which are similar or identical to those disclosed in the aforementioned J. J. Bernardis and S. M. Lin patents and BSDB publication.

Associated with the services management system 14 is a customer data base 16 which contains detailed information concerning the customers utilizing telephone network 18. Also associated with services management system 14 is a further computer workstation 15 which can be used to add customer preferences and other customer specific data to the service templates

defined in store 19. This addition of the customer specific data to a service template is called "service provisioning" and permits the service templates passed to service control point 17 to be customized for a particular customer or set of customers using network 18. Workstation 15 can, of course, be combined with workstation 10 if the two workstations are at the same location.

The workstations 10 and 15 can be any modern workstation supporting graphical manipulation capability. One such workstation is the SUN 3/160 terminal running under the SUN operating system and using the SUNVIEW® graphics environment. This environment provides window support, mouse control, and graphic creation and manipulation capability adequate to implement the present invention. Many other modern workstations, however, would likewise support implementations of the present invention.

The present invention will be better understood by considering the flowchart of FIG. 2. In FIG. 2 there is shown a flowchart of the process for designing and deploying new services for telephone subscribers in accordance with the present invention. Three major steps are involved, node definition, service definition and call processing record creation. These steps will be taken up individually below.

The intended user of the process of FIG. 2 is the service creator, typically the telephone service provider. As suggested in box 20 of FIG. 2, this person must create the nodes to be used in new services. The new nodes are created dynamically by specifying the following properties of the new node.

1. Node Name
2. Node Type
3. Data Type
4. Node Rules
5. "Other" Allowed
6. Node Error Message
7. Notes

As is shown in detail in FIG. 3, a node definition screen can be used to capture the node properties as data items. The "Load," "Validate," "Store," "Delete," "Browse," "Help," and "Quit" command buttons are utilized to access and process nodes as entities. The data acquisition fields are used to define new nodes by specifying the node name and the node properties. Using

these properties, a node can be administered by the service management system 14 of FIG. 1 and implemented by the service control point 17 of FIG. 1 without the necessity of writing new service implementing code. As illustrated in FIG. 3, the user is presented with an on-screen form which requires that the user specify the values for each of these properties. The cursor initially is located at the first data field (**NODE NAME:**) and advances to successive data fields as the <enter> or <return> key is depressed. Once these properties have been specified, the user can store the completed node definition for the newly created node in a node library in store 12 (FIG. 1), using the command keys identified in the top portion of the screen display of FIG. 3.

The properties captured by the node definition screen of FIG. 3 contain key information about the new node and, when necessary, can be translated and sent to the service control point 17 of FIG. 1 to drive a generic Call Processing Record (CPR) interpreter (such as that disclosed in the aforementioned Bernardis patent), so that it can support the use of this new node in any call processing records that are created and provisioned for services. Additional or supplemental properties, such as associated service control point call variables, node connection rules and node translation rules, can be added to the node library at a later time to completely characterize the meaning and intent of these operations at a particular services management system 14 and a particular service control point 17 (FIG. 1) in a generic manner. More particularly, a specific identification of the service implementing primitive in one or more service implementing network components which can be used to realize the node can be explicitly added to the node definition. The presence of such an identification of the actual code sequence in the service control point would substantially simplify the design of the interpretor program which translates the call processing record into actual service implementation. In this sense, the nodes become elements of an extendible, high level programming language for specifying telephone services.

In response to the **NODE NAME** prompt, the user supplies any unique name chosen for the new node. This name will hereafter be used to identify the node. This new node name can be thought of as a higher-level abstraction representing a specific operation using pre-defined call processing variables. Nodes can be either decision nodes or action nodes. The following

node types, supplied in response to the NODE TYPE prompt, are possible:

TABLE 1

NODE TYPES

ACTION NODES	DECISION NODES
Assignment Action	Branch Decision
Boolean Operation Action	Integer Decision
Collect Action	Percent Decision
Connect Action	String Decision
Concatenate Action	
CPR Access Action	
Diagnostic Action	
Return Action	
Table Access Action	
Temporary Hand Over Action	
Terminate Action	

The node type selected provides information that can be used during call processing record validation and call processing record code generation. These node types correspond to all of the basic types of actions and decisions that might be utilized in providing telephone special services. They are already programmed or programmable into prior art service implementing network components such as service control point 17. Should a new type of node be required, however, it is necessary to specify the new type, and to provide generic implementation of the activity of the new node type in the service control point 17.

The node types have particular meaning to service control point 17, which must execute the call processing record in real time. Specifically, the node type informs service control point 17 what functions or call primitives are to be invoked. These node types thus represent the "programmed capabilities" of service control point 17, which, when combined with the node

name, representing a particular pre-defined call variable in the service control point call processing execution environment, enable service control point 17 to actually perform the requested operations using the correct data.

The **DATA TYPE** field specifies the format of the data that will be acceptable as input values for this node when this node is used in a call processing record. The data formats allowed are decimal numbers, alphanumeric text, telephone numbers, trunk identifiers, variable data, and billing information. The data type is used during call processing record validation at the time the call processing record is "provisioned" by the specification of customer-dependent data values.

To administer a call processing record, services management system 14 of FIG. 1 must be able to determine whether valid values have been entered for the nodes in the the call processing record tree. Therefore the user must specify the rules to be used when validating the input values for this node when this node is used in a call processing record. In accordance with the present invention, a regular expression can be used to represent the validation rules. Moreover, such validation rules can be entered dynamically in the node definition as opposed to hard coding them in a program. For example, to specify the validations for a queuing node, the user can specify the regular expression "^(lifo | fifo)$". This expression states that the node can accept either "last in, first out" or "first in, first out" queue behavior as input values.

In response to the **OTHER ALLOWED**, prompt, the user must specify whether the node can accept the word "other" as an input value. For example, if a day of the week node were defined and available for a particular service, a call processing record would be constructed with the day of the week node in the tree. If the input values for the day of the week node were specified as "Monday and Tuesday," then a second branch would need to be created to cover what should be done on Saturday, Sunday, Wednesday, Thursday and Friday. Rather than spell out the remaining days, the string "other" could be used. For some nodes "other" is not a sensible value. Therefore, during node definition, the user must indicate whether "other" is a valid input value or whether entering "other" should result in a validation error.

In response to the **NODE ERROR MESSAGE** prompt, the user enters a string to be printed when an inappropriate input value is specified for a

node during the provisioning of a call processing record. This allows "on the fly" validation of data entries during all succeeding uses of this node definition.

The **NOTES** prompt permits a convenience field for the user. It can be used to note limitations on the node behavior, a general functional description of the node or any other information the user wishes to associate with the node definition.

Also shown at the top of screen 30 of FIG. 3 are a series of command light buttons labeled "Load," "Validate," "Store," "Delete," "Browse," "Help," and "Quit." These command buttons are operated, for example, by a mouse-driven cursor, to accomplish the associated screen display control functions. For example, "Load" will load any particular previously existing node definition (e.g., for editing) simply by giving the node name and evoking the "Load" command. Similarly, "Validate" performs the validation on the data entries made in response to the prompts. "Store" stores the newly defined node in the node library 12 of FIG. 1. The "Delete" command deletes the identified node definition from library 12. "Browse" allows the user to browse through all of the previously defined nodes, "Help" provides screens of useful ancillary information likely to be of assistance to the user during the node definition activity, and "Quit" allows the user to terminate the node definition activity. The implementation of these so-called "command buttons" are well-known in the art and will not be further described here.

Returning to FIG. 2, the second box 21 represents the activity of defining a new service in terms of previously defined nodes. In this context, a "record" is a service definition and box 21 includes "Load," "Validate" and "Store" commands for these service definition records. In addition, box 21 includes "Canvas" commands. These commands permit the visual and graphical manipulation of previously defined nodes into service definitions. As can be better seen in FIG. 4, the left half of the screen 40 is the drawing area where visual representations of previously defined nodes can be assembled into service definitions. The "Canvas" commands include "Clear" (to clear the canvas area), "Draw" (to prepare for manipulating items on the canvas), "Help" (to obtain screens of useful information to assist in the use of the system), and "Quit" (to terminate the service definition session). In addition, individual items in the canvas area can be manipulated with the commands "Select" (to select a

particular node), "Add" (to add a selected node to the service definition), "View" (to view the node definition of the selected node), and "Delete" (to delete a node from the service definition).

The intended user of the service definition process is the service creator. This creator utilizes the service definition process to define the subset of nodes in the node library that are to be used in a specific service. The user is presented with the form shown in FIG. 4 which enables the user to specify the nodes from the node library that are allowed for use by a specific service with a certain qualifier. A qualifier could, for example, be a specific area of service in the service provider's territory. With the functions described above, the use of any particular node in a service can be defined by a service creator and administered by the service management system 14. Once the allowable node names for a particular service have been specified, using the screen 40 of FIG. 4, the user can store the service definition for the new service in service definition tables 12 (FIG. 1). These service definitions can thereafter be edited, augmented or deleted from the service definition tables 12 whenever desired.

The service creation user can distribute the node library and the service definition tables in store 12 to the generic service management system 14 for use in administering the new service. Services management system 14 will permit the use of only the specified subset of nodes in all call processing records that are created and provisioned for this particular service. Additional properties, such as service-specific node connection rules and node translation rules, can be added to the service definition tables at this time to completely and generically characterize the meaning and intent of these operations for the service management system 14.

Returning to FIG. 2, the box 22 represents the procedures for "provisioning" the service defined in box 21. In this regard, the term "provisioning" means creating the logic tree representing the new service and customizing the defined service in terms of node parameter values. The screen 50 of FIG. 5 illustrates a mechanism for carrying out this process. The service creator can use this process to define a default representation of the service offering as a template of nodes interconnected in a call processing record tree format. The allowed nodes for a particular service are the ones specified through the service definition process. The service provisioning user can use this

process to customize the default service template and to provision the service with node parameter values. The user is presented with the visual programming tool illustrated in FIG. 5 to enable a graphical, user-friendly specification and input of the appropriate service customization and provisioning information, based on service, qualifier and customer key information. The qualifier could be, for example, a specific area of service in the service provider's territory. The screen of FIG. 5 provides record manipulation functions (Load Record, Validate Record, Store Record, and Translate Record), node manipulation functions (Place, Connect, Move, Edit, Disconnect, and Remove), and draw commands (Select, Clear, Help, Quit, and Redraw).

With the above described functions, the user can define a service template of nodes interconnected in a call processing record tree format as a default representation of the service offering. Furthermore, the true power of the present invention becomes evident when it is realized that the service creator can define modular templates of common reusable node-based logic as service features, which can then be added to the node library as nodes for reuse by other features and services. In effect, the present invention provides a mechanism for using the set of "programmable capabilities" available at the service control point 17 and define reusable, user-friendly and high-level modules that enable easier and faster visual programming of the call processing logic.

It should be noted that assemblies of low level nodes can be associated together into a higher level capability which, once given a name, can be retrieved, manipulated and used in creating new services just like a low level node. In this way, as time proceeds, the creation of new services becomes easier and easier since ever higher levels of service primitives become available for assembly into the new services.

Once the default service template has been specified, the user can store the service template definition for the new service in service template definition store 19. The user can thereafter distribute these service template definition tables to the generic services management system 14 for use in administering the new service, providing a default service logic flow for the purpose of provisioning. Furthermore, the availability of service node definitions in store 13 will ensure that provisioning will support the use of only the creator-specified subset of nodes in any call processing records that are customized and

provisioned for this particular service.

The service provider or the subscriber can also use the process illustrated in FIG. 5 to customize the default service template and to provision the service by providing node parameter values. At this stage, the node values supplied are validated dynamically by invoking the node validation rules specified for each node name in the node library. Additional node and service definition properties, such as node connection rules and node translation rules, can be specified to drive the validation and translation operations at the services management system 14 in a generic manner.

The attached Appendix provides psuedocode for implementing the flowchart of FIG. 2. With this pseudocode and the description herein provided, any person of ordinary skill in the programming art is able to fully implement the present invention.

It should also be clear to those skilled in the art that further embodiments of the present invention may be made by those skilled in the art without departing from the teachings of the present invention.

APPENDIX
Pseudocode

Node Definition Process Pseudocode

```
invoke ('node_definition')

do until (invoke ('quit'))

    if (view (node_definition))
        then input (node_name)
            invoke ('load')
            if (node_definition (node_name) in library
                then
                    retrieve (node_definition (node_name))
                    display (node_definition (node_name))
                else
                    create (node_definition_window (node_name))
                    display (node_definition_window (node_name))
            endif
            end_invoke
    endif

    if (specify (node_properties))
        then
            set_default (field_values (node_name))
            enter (field_values (node_name))
        else
            if (modify (node_properties))
                then update (field_values (node_name))
            endif
    endif

    if (validation_check (node_name))
        then
            invoke ('validate')
                verify (node_name, field_entries, field_entry_combinations)
            end_invoke
    endif

    if (store (node_definition))
        then
            invoke ('store')
                retrieve (node_definition (node_name))
```

```
                overlay (node_definition, node_properties)
                store (overlay (node_name))
            end_invoke
        endif

        if (delete (node_definition))
            then
                invoke ('delete')
                    retrieve (node_definition (node_name))
                    delete (node_definition (node name))
                end_invoke
        endif

        if (browse (node_definition)
            then
                invoke ('browse')
                    display (node_properties)
                    retrieve (node_definitions)
                    display (node_definitions)
                end_invoke
        endif

    end_do
```

Service Definition Process Pseudocode

```
invoke ('service_definition')

do until (invoke ('quit'))

    if view (service_definition)
        then
            input (service_name, service_qualifier)
            invoke ('load')
                retrieve (service_definition (service_name, serivce_qualifier))
                display (node_name_list)
            end_invoke
    endif

    if view (all_nodes)
        then
            invoke ('select')
                generate (menu (all_nodes))
            end_invoke
    endif

    if (select_node)
        then
            invoke ('select')
                select (desired_node, menu (all_nodes))
                display (desired_node, current_node_display)
            end_invoke
    endif

    if use (current_node)
        then
            invoke ('add')
                position (current_node, canvas)
                add (current_node, service_definition)
            end_invoke
    endif

    if disallow (current_node)
        then
            invoke ('delete')
                select (current_node)
                delete (selected_node)
            end_invoke
    endif
```

```
if view (current_node_definition)
    then
        invoke ('view')
            select (current_node)
            display (node_definition, current_node)
        end_invoke
endif

if validate (service_definition)
    then
        invoke ('validate')
            verify (field_entries, service_definition)
            verify (field_entry_combinations, service_definitions)
        end_invoke
endif

if store (service_definition)
    then
        invoke ('store')
            retrieve (service_definition (service_name, service_qualifier))
            overlay (service_definition (service_name, serivce_qualifier),
                    canvas_nodes))
            store (service_definition (service_name, service_qualifier))
        end_invoke
endif

if clear (canvas_area)
    then
        invoke ('clear')
            clear (all_nodes, canvas_area)
        end_invoke
 endif

if redraw (canvas_area)
    then
        invoke ('draw')
            clear (all_nodes, canvas_area)
            auto_invoke ('load')
        end_invoke
endif

end_do
```

CPR Input Process Pseudocode

```
invoke ('CPR_input')

do until invoke ('quit')

    if view (existing_CPR_tree)
        then
            input (service_name, qualifier_name, customer_name)
            invoke ('load')
                retrieve (node_names (service_name, service_qualifier))
                retrieve (node_definitions (node_names)
                retrieve (CPR_tree (service_name, service_qualifier,
                        customer_name))
                display (CPR_tree (service_name, service_qualifier,
                        customer_name))
            end_invoke
    endif

    if view (allowed_nodes (service_name, service_qualifier))
        then
            invoke ('select')
                generate (menu (allowed_node_names))
            end_invoke
    endif

    if select (allowed_node)
        then
            invoke ('select')
                identify (desired_node)
                display (desired_node, current_node)
            end_invoke
    endif

    if add (current_code, CPR_canvas)
        then
            invoke ('place')
                position (current_node, CPR_canvas)
                place (current_node, CPR_canvas)
            end_invoke
    endif

    if connect (node_name1, node_name2, CPR_canvas)
        then
            invoke (connect)
```

```
                select (from_node)
                select (to_node)
                draw_line (from_node, to_node)
            end_invoke
    endif

    if move (node_name)
        then
            invoke (move)
                erase (node_name, old_location)
                redraw (node_name, new_location)
                redraw (connections, old_location, new_location)
            end_invoke
    endif

    if edit (node_name, node_value)
        then
            invoke ('edit')
                select (node_name)
                display (edit_menu)
                input (node_value)
                invoke ('enter')
                    erase (old_value)
                    display (new_value)
                end_invoke
            end_invoke
    endif

    if disconnect (node_name)
        then
            invoke ('disconnect')
                select (node_name)
                erase_connection (node_name, node_parent)
            end_invoke
    endif

    if remove (node_name)
        then
            invoke ('remove')
                select (node_name)
                remove (node_name, children, connections)
            end_invoke
    endif

    if validate (CPR_node)
```

```
            then
                invoke ('validate')
                    for (each node in CPR_tree)
                    do
                        validate (node_value, node_rule)
                    end_do
                    display (error_messages)
                    correct (node_values, connections)
                end_invoke
        endif

        if store (CPR_tree)
            then
                invoke ('store')
                    retrieve (CPR_tree (service_name, service_qualifier,
                            customer_name))
                    overlay (CPR_tree (service_name, service_qualifier,
                            customer_name), CPR_tree (canvas_area))
                    store (CPR_tree, overlay)
                end_invoke
        endif

        if clear (canvas_area)
            then
                invoke ('clear')
                    erase (canvas_area)
                end_invoke
        endif

        if redraw (canvas_area)
            then
                invoke ('redraw')
                    erase (canvas_area)
                    auto_invoke ('load')
                end_invoke
        endif

    end_do
```

What is claimed is:

1. A system for defining software implemented services in a telephone network having programmable facilities for executing customer service primitives, said system comprising

means for specifying a plurality of reusable nodes for call processing record logic trees in terms of said service primitives,

means for defining a subset of said nodes to be used in one of said telephone services,

graphical means for assembling said subset of nodes into one of said call processing record logic trees, and

means for storing said one call processing record logic tree to be used for providing said telephone service to a group of telephone subscribers.

2. The system according to claim 1 wherein said means for specifying nodes comprises

means for assembling a plurality of said nodes into a customer service feature call processing record logic tree, and

means for storing and retrieving said customer service feature as a single node to be used in said call processing record logic trees.

3. The system according to claim 1 wherein said means for specifying nodes comprises

means for specifying the name of one of said nodes.

4. The system according to claim 1 wherein said means for specifying nodes comprises .

means for specifying the node type of said one node.

5. The system according to claim 1 wherein said means for specifying nodes comprises

means for specifying the data type of parameter values associated with said one node.

6. The system according to claim 4 wherein said means for specifying nodes comprises

means for specifying validation rules for parameter values associated with said one node, and

means for specifying an error message to be displayed in response to the failure of either said data type or said parameter values to satisfy said

validation rules.

7. The system according to claim 1 wherein said graphical means for assembling includes

means for display selected ones of said specified nodes.

8. The system according to claim 1 wherein said graphical means for assembling includes

means for adding a specified node to said call processing record logic tree.

9. The system according to claim 1 wherein said graphical means for assembling includes

means for deleting a specified node from said call processing record logic tree.

10. The system according to claim 1 wherein said graphical means for assembling includes

means for interconnecting two specified nodes in said call processing record tree.

11. The method for defining telephone services for implementation in a telephone network, said method comprising the steps of

specifying the nodes of a plurality of call processing record trees,

assembling a subset of said specified nodes to be used in a one of said telephone services,

graphically interrelating said assembled nodes into a logical graph representing a telephone service call processing sequence, and

storing said logical graph in a library of logical graphs to be used in providing the defined telephone service.

12. The method according to claim 10 wherein said step of specifying nodes comprises the step of

specifying the name of one of said nodes.

13. The method according to claim 10 wherein said step of specifying nodes comprises the step of

specifying the node type of said one node.

14. The method according to claim 10 wherein said step of specifying nodes comprises the step of

specifying the data type of parameter values associated with said one node.

15. The method according to claim 13 wherein said step of specifying nodes comprises the steps of

specifying validation rules for parameter values associated with said one node, and

specifying an error message to be displayed in response to the failure of either said data type or said parameter values to satisfy said validation rules.

16. The method according to claim 10 wherein said step of graphically interrelating includes the step of

displaying selected ones of said specified nodes.

17. The method according to claim 10 wherein said step of graphically interrelating includes the step of

adding a specified node to said call processing sequence.

18. The method according to claim 10 wherein said step of graphically interrelating includes the step of

deleting a specified node from said call processing sequence.

19. The method according to claim 10 wherein said step of graphically interrelating includes the step of

interconnecting two specified nodes in said call processing sequence.

FIG. 1

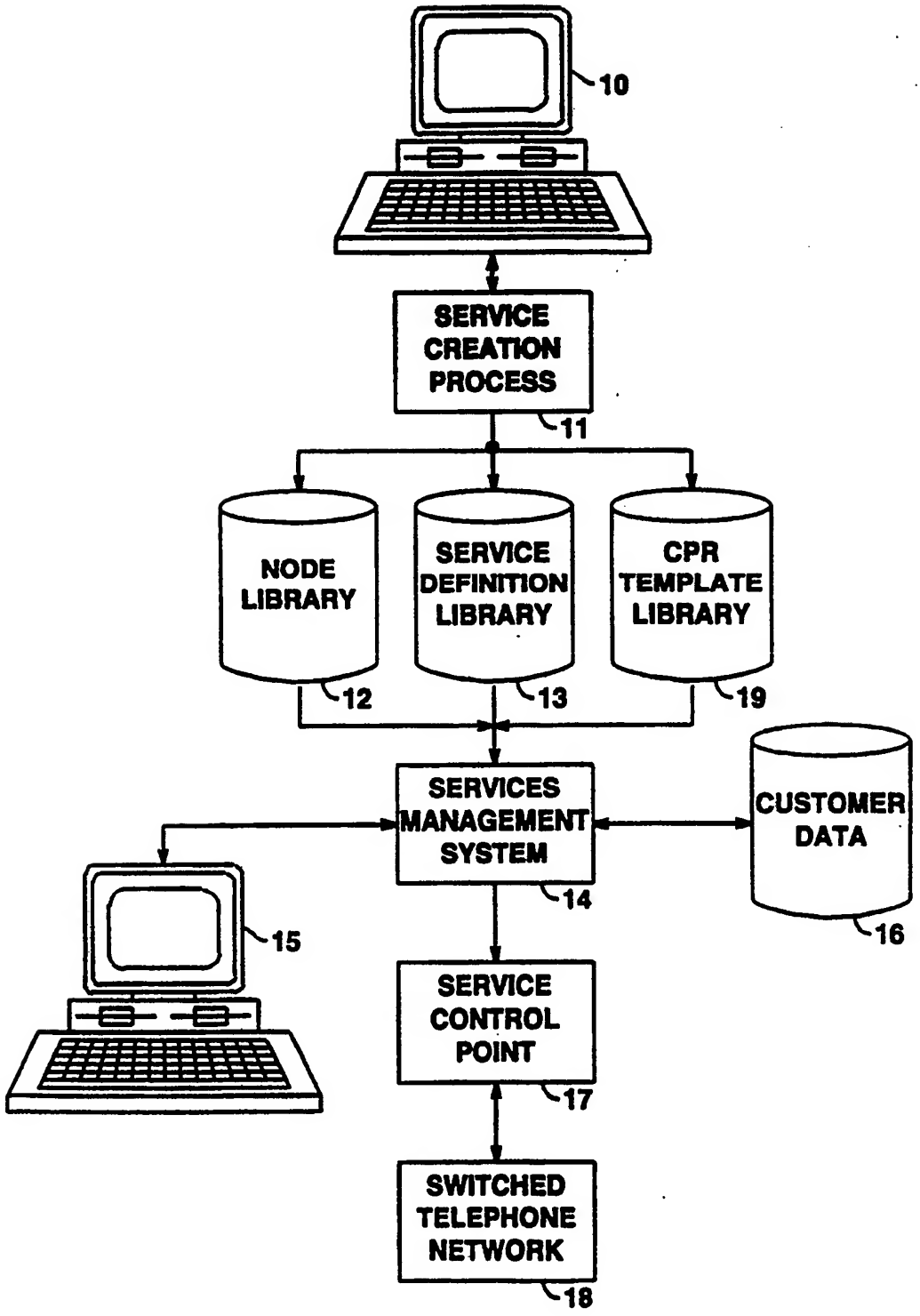

10
SERVICE CREATION PROCESS
11
NODE LIBRARY
SERVICE DEFINITION LIBRARY
CPR TEMPLATE LIBRARY
12
13
19
SERVICES MANAGEMENT SYSTEM
14
CUSTOMER DATA
16
15
SERVICE CONTROL POINT
17
SWITCHED TELEPHONE NETWORK
18

FIG. 2

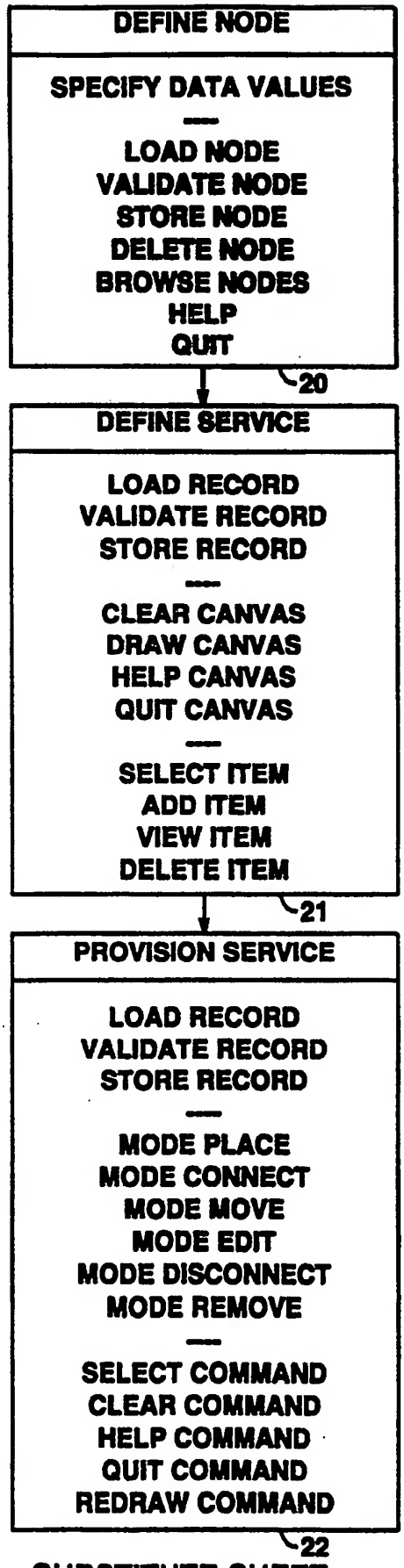

DEFINE NODE
SPECIFY DATA VALUES
LOAD NODE
VALIDATE NODE
STORE NODE
DELETE NODE
BROWSE NODES
HELP
QUIT
20
DEFINE SERVICE
LOAD RECORD
VALIDATE RECORD
STORE RECORD
CLEAR CANVAS
DRAW CANVAS
HELP CANVAS
QUIT CANVAS
SELECT ITEM
ADD ITEM
VIEW ITEM
DELETE ITEM
21
PROVISION SERVICE
LOAD RECORD
VALIDATE RECORD
STORE RECORD
MODE PLACE
MODE CONNECT
MODE MOVE
MODE EDIT
MODE DISCONNECT
MODE REMOVE
SELECT COMMAND
CLEAR COMMAND
HELP COMMAND
QUIT COMMAND
REDRAW COMMAND
22

FIG. 3
NODE DEFINITION

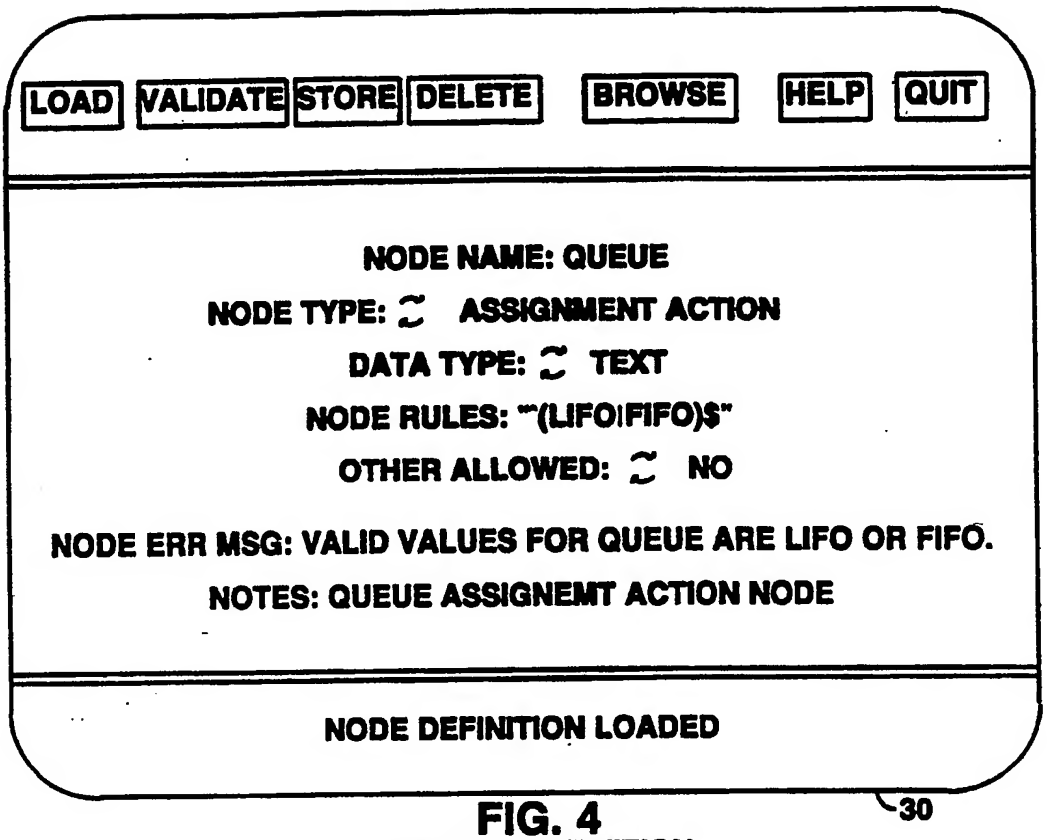


FIG. 4
SERVICE DEFINITION

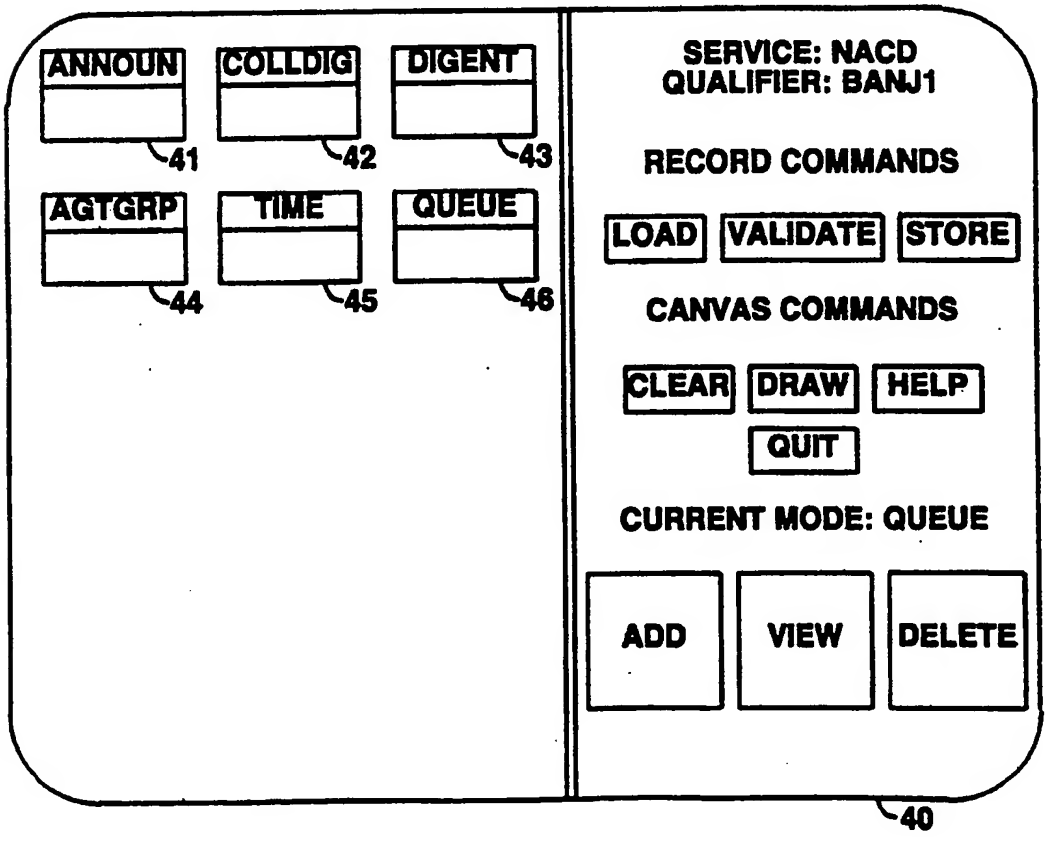
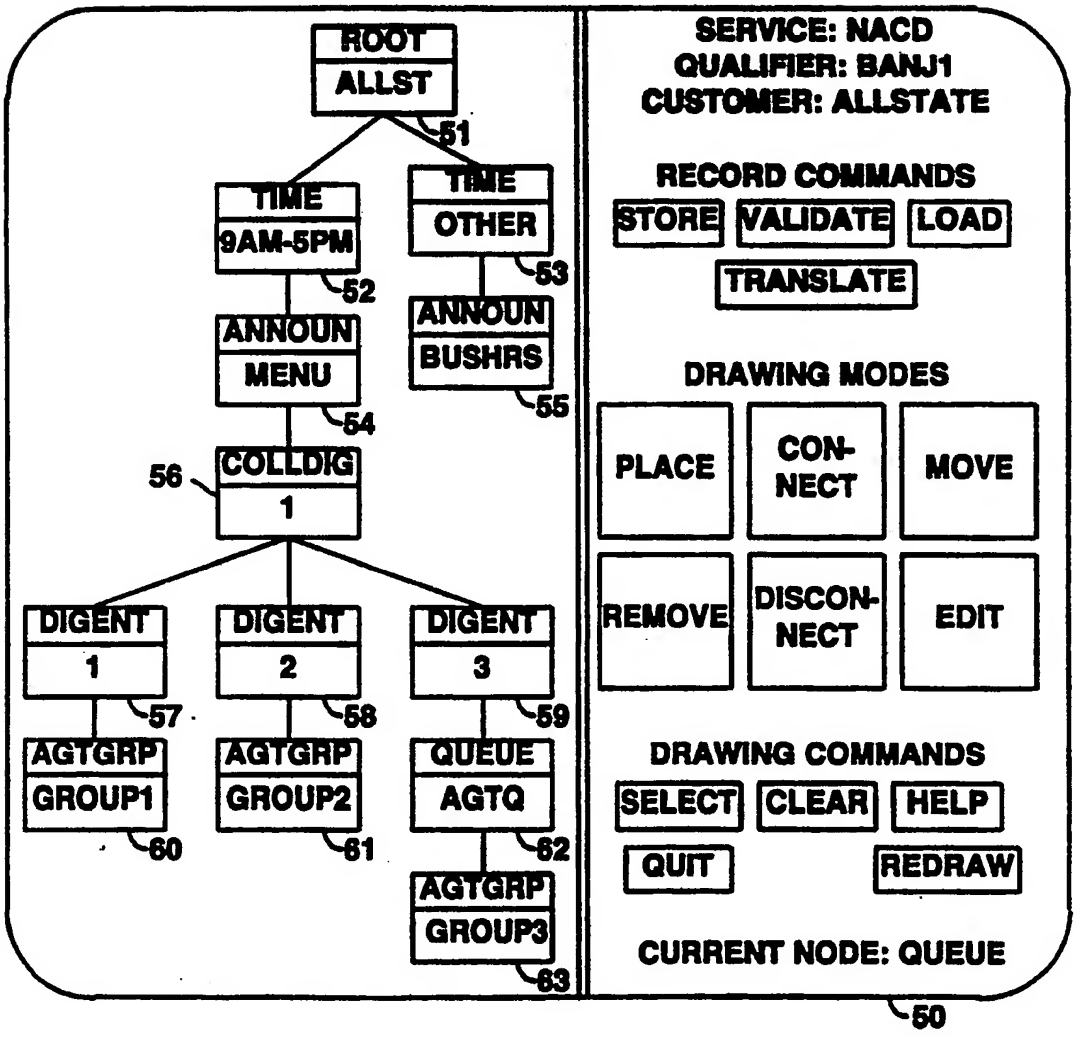


FIG. 5

CALL PROCESSING RECORD CREATION



INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/09456

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (5): H04M 3/42

U.S.Cl.: 379/201

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System [8]	Classification Symbols
U.S.Cl.	379/201,204,207,211

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [9]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	US, A, 4,611,094 (ASMUTH ET AL.) 09 September 1986 See abstract.	1-19
A,P	US, A, 5,060,255 (BROWN) 22 October 1991 See abstract.	1-19

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
20 February 1992	19MAR 1992

International Searching Authority	Signature of Authorized Officer
ISA/US	for Harry S. Hong NGUYEN NGOC-HO INTERNATIONAL DIVISION

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